

(19) World Intellectual Property Organization
International Bureau



(43) International Publication Date
31 July 2003 (31.07.2003)

PCT

(10) International Publication Number
WO 03/062894 A1

(51) International Patent Classification⁷: G02B 6/42

B-3000 Leuven (BE). BELLEKENS, Kathleen [BE/BE];
Ellestraat 26A, B-3020 Winksele-Delle (BE).

(21) International Application Number: PCT/GB03/00059

(22) International Filing Date: 9 January 2003 (09.01.2003)

(74) Agent: JAY, Anthony, William; Tyco Electronics UK
Ltd, European Patent Department, Faraday Road, Dorcan,
Swindon, Wiltshire SN3 5HH (GB).

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
0201113.8 18 January 2002 (18.01.2002) GB

(81) Designated States (*national*): AE, AG, AL, AM, AT, AU,
AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU,
CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH,
GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC,
LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW,
MX, MZ, NO, NZ, OM, PH, PL, PT, RO, RU, SC, SD, SE,
SG, SK, SL, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ,
VC, VN, YU, ZA, ZM, ZW.

(71) Applicant (*for all designated States except MG, US*):
TYCO ELECTRONICS RAYCHEM NV [BE/BE];
Diestsesteenweg 692, B-3110 Kessel-Lo (BE).

(84) Designated States (*regional*): Eurasian patent (AM, AZ,
BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE,
BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU,
IE, IT, LU, MC, NL, PT, SE, SI, SK, TR).

(71) Applicant (*for MG only*): TYCO ELECTRONICS UK
LTD [GB/GB]; Faraday Road, Dorcan, Swindon, Wiltshire
SN3 5HH (GB).

Declaration under Rule 4.17:
— of inventorship (Rule 4.17(iv)) for US only

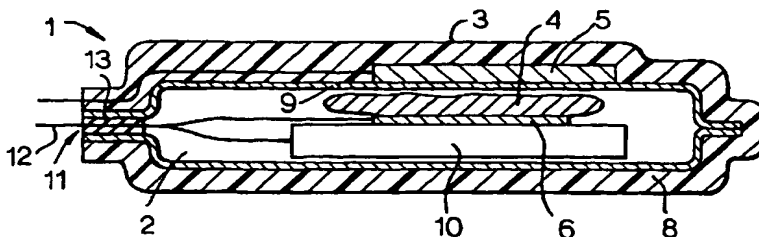
(72) Inventors; and

(75) Inventors/Applicants (*for US only*): LEEMAN, Sam
[BE/BE]; Volmolenlaan 6/00.02, B-3000 Leuven (BE).
FRANCKX, Joris [BE/BE]; Halmenhoek 7, B-2820
Bonheiden (BE). WATTE, Jan [BE/BE]; Molenstraat
168, B-1851 Grimbergen (BE). MATTHEUS, Walter
[BE/BE]; Gemeentestraat 199, B-3010 Kessel-Lo (BE).
MEURS, Paul [BE/BE]; Vaartstraat 40, bus 01-03,

Published:
— with international search report

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: ENCLOSED OPTICAL CIRCUITS



(57) Abstract: A device (1) for sealingly enclosing at least one optical circuit (10), the device comprising a container (3) and a humidity control means (4) accommodated in the container (3). The device is characterised by temperature control means (5, 6) arranged in the container (3). The container (3) is preferably flexible.

WO 03/062894 A1

THIS PAGE BLANK (USPTO)

ENCLOSED OPTICAL CIRCUITS

The present invention relates to enclosed optical circuits. More in particular, the present invention relates to a device and a method for sealingly enclosing at least one optical circuit.

5 It is well known that moisture has adverse effects on the properties of optical components. The split ratio of optical splitters, for example, may be influenced by the presence of moisture, and in filters and mirrors moisture may cause degrading of their optical characteristics. The sealing of optical components against moisture and other environmental influences, in other words environmental sealing, is therefore highly
10 desirable.

It has been proposed to environmentally seal individual optical components. This is, however, relatively expensive and not always effective.

15 In the case of electrical or electronic components it is known to seal an entire circuit by enclosing it in a flexible, moisture-resistant bag. WO 94/18815 (Ericsson), for example, discloses a casing for flexibly enclosing electronic circuitry. The casing comprises a laminate consisting of metal and plastic sheets. Two sheets of laminate are joined to form an envelope in which electronic circuitry may be accommodated.
20 Electrical conductors pass through the joint region of the laminate.

Although such an arrangement may be effective for sealing electronic circuits, it is less suitable for optical components or circuits. The present inventors have found that the performance of optical components and/or circuits can be significantly improved by
25 providing a controlled environment, that is, an environment in which both the humidity and the temperature are controlled. Conversely, the failure rate of optical components and/or circuits can be significantly reduced by a suitably controlled environment.

It is known for a flexible container to contain a desiccant to control the moisture
30 level within the container. The present invention seeks to improve the environment of

optical circuits by providing a device for sealingly enclosing at least one optical circuit, the device comprising a container and a humidity control means accommodated in the container, characterised by temperature control means arranged in the container.

- 5 By providing temperature control means in addition to humidity control means (such as desiccant) a further reduction of the possibility of condensation within the device can be achieved, while in addition excessively high temperatures can be avoided.

The container is preferably substantially flexible but may also be substantially
10 rigid, or some parts may be flexible while others are rigid.

The temperature control means may comprise a heat sink or a heat pipe, and/or an active temperature controller such as a heater (e.g. electrical) and/or an active cooling element. It will be understood that the container provides a moisture barrier and may be
15 hermetically sealed. Preferably, the container provides a thermal barrier as well.

In first embodiment of the device according to the present invention, the temperature control means are accommodated in a wall of the container. To this end a cavity may be provided in the wall to accommodate the temperature control means.
20

In a second embodiment, the temperature control means are accommodated in a space defined by the container. That is, the temperature control means are located in the space where the optical circuit(s) is (are) located, preferably adjacent the optical circuit(s). Advantageously, the temperature control means are accommodated between the at least
25 one optical component and a desiccant means.

In a third embodiment, at least two temperature control means are provided, one being located in a wall of the container and another in the space defined by the container. In this way, an even higher degree of temperature control can be achieved.
30

In a preferred embodiment the container comprises an insulating layer and a

- 3 -

moisture barrier layer. The moisture barrier layer is preferably located on the inside of the container.

In a particularly advantageous embodiment the device has an opening for feeding optical fibres therethrough, said opening being sealed by sealing strips to which heat and/or pressure is applied, said sealing strips preferably being made of plastic. Such a sealing arrangement is described in British Patent Application GB 0110366.2.

The present invention further provides a kit-of-parts for forming a device as defined above, and a method of sealingly enclosing at least one optical circuit, the method comprising the steps of providing a container, providing a humidity control means, providing a temperature control means and accommodating the at least one circuit, the humidity control means and the temperature control means in the container.

The invention will further be explained below with reference to the accompanying drawings, in which:

Figure 1 schematically shows, in cross-sectional view, a first embodiment of a device according to the present invention.

Figure 2 schematically shows, in perspective, a second embodiment of a device according to the present invention.

The device 1 shown merely by way of non-limiting example in Fig. 1 comprises a flexible container 3 which is in the form of an envelope, enclosing a space 2. The walls of the container 3 are shown to consist of two layers, an outer insulating layer 8 and an inner moisture barrier layer 9. The insulating layer 8 is preferably made of polyethylene or polyurethane, while the moisture barrier layer 9 is preferably made of aluminium. These layers may form a laminate of the kind used in Raychem's TDUX™ products, as disclosed in EP 0 579 641 and other patents. When properly sealed, such a laminate has an extremely low water vapour transmission rate (WVTR).

The access opening 11 of the container 3 is sealed by sealing strips 13 which enclose optical fibres 12. An optical circuit 10 and a humidity control means 4

(preferably a desiccant) are accommodated in the space 2.

In accordance with the present invention the device is provided with at least one temperature control unit. In the embodiment shown, a first temperature control unit 5 is accommodated in the space 2 defined by the container 3 and a second temperature control unit 6 is accommodated in a cavity provided in a container wall 7.

Although two temperature control units 5, 6 are shown in Fig. 1, it is preferred that only a single temperature control unit is present in a device 1.

The temperature control units 5, 6 may be active or passive and may comprise a heat sink, a heat pipe, a Peltier element or other suitable heat control elements. In the case of active elements, electrical leads (not shown) are passed through the opening 11 and sealed by the sealing strips 13.

The embodiment of Fig. 2 is particularly suitable for small optical circuits consisting of only one or two components. In Fig. 2A, a single optical component 10 is enclosed by a relatively rigid container 3' which is preferably constituted by a metal sleeve. The strips 13, which are preferably made of a polymer, are bent in a ring-shape so as to seal both ends (openings 11) of the container 3'. A humidity and/or temperature control unit 4, 5 is approximately tubularly shaped so as to fit around the optical component 10. Optical fibres 12 are connected to the optical component 10. When the device 1 is assembled, the strips 13 are located near the ends of the container 3', as shown in Fig. 2B. Then heat is applied to the end regions, as shown in Fig. 2C, to seal the device 1. To this end, suitable heat-generating dies 15 are used which are pressed together to effect the seal.

It will be understood by those skilled in the art that the present invention is not limited to the embodiments shown and that many additions and modifications are possible without departing from the scope of the present invention as defined in the appending claims.

Claims

1. Device (1) for sealingly enclosing at least one optical circuit (10), the device comprising a container (3) and a humidity control means (4) accommodated in the container (3),
5 characterised by temperature control means (5, 6) arranged in the container (3).
2. Device according to claim 1, wherein the container (3) is substantially flexible.
- 10 3. Device according to claim 1, wherein the container (3) is substantially rigid.
4. Device according to claim 1, 2 or 3, wherein the temperature control means (5) are accommodated in a wall (7) of the container (3).
- 15 5. Device according to any of the preceding claims, wherein the temperature control means (6) are accommodated in a space (2) defined by the container (3).
6. Device according to claim 5, wherein the temperature control means (6) are accommodated between the at least one optical component (1) and a humidity
20 control means (4).
7. Device according to any of the preceding claims, wherein the temperature control means (5, 6) comprise an active temperature controller.
- 25 8. Device according to any of the preceding claims, wherein the temperature control means (5, 6) comprise a heat sink.
9. Device according to any of the preceding claims, wherein the container (3) comprises a heat insulating layer (8) and a moisture barrier layer (9).
- 30 10. Device according to any of the preceding claims, having an opening (11) for feeding optical fibres (12) therethrough, said opening being sealed by sealing strips

(13) to which heat and/or pressure is applied, said sealing strips preferably being made of plastic.

5 11. Device according to any of the preceding claims, wherein at least one optical circuit (10) is accommodated, said circuit preferably comprising active and/or passive optical components.

12. Device according to any of the preceding claims, wherein the at least one optical circuit (10) consists of a single optical component.

10 13. Kit-of-parts for forming a device (1) according to any of the preceding claims.

14. Method of sealingly enclosing at least one optical circuit (10), the method comprising the steps of:

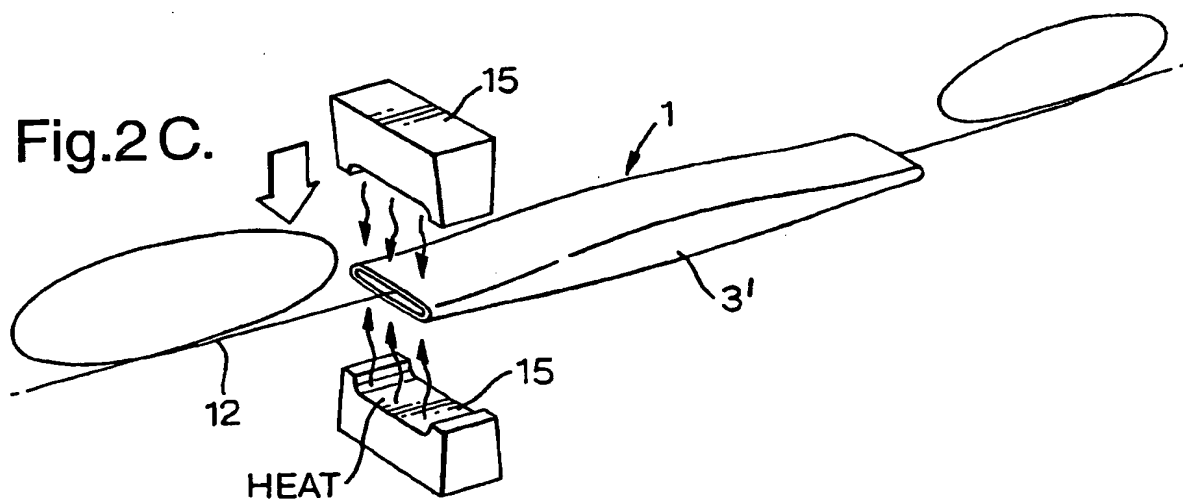
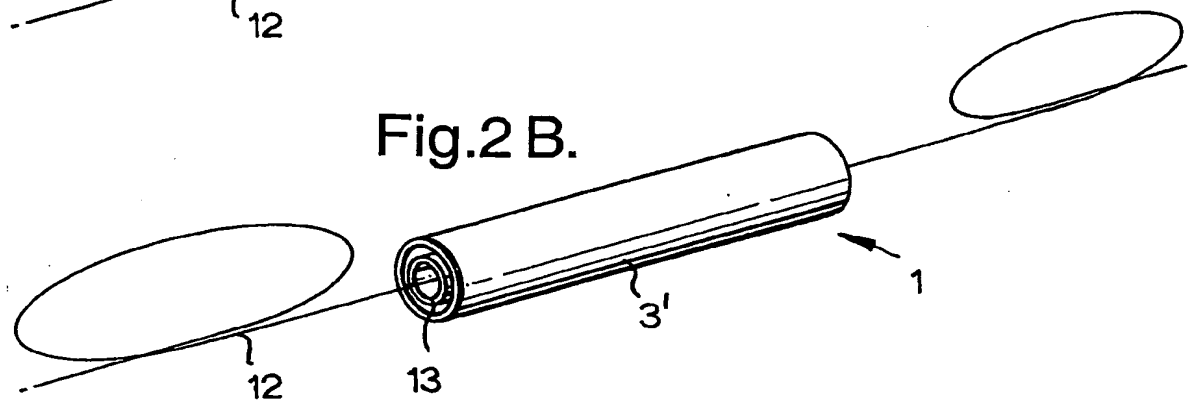
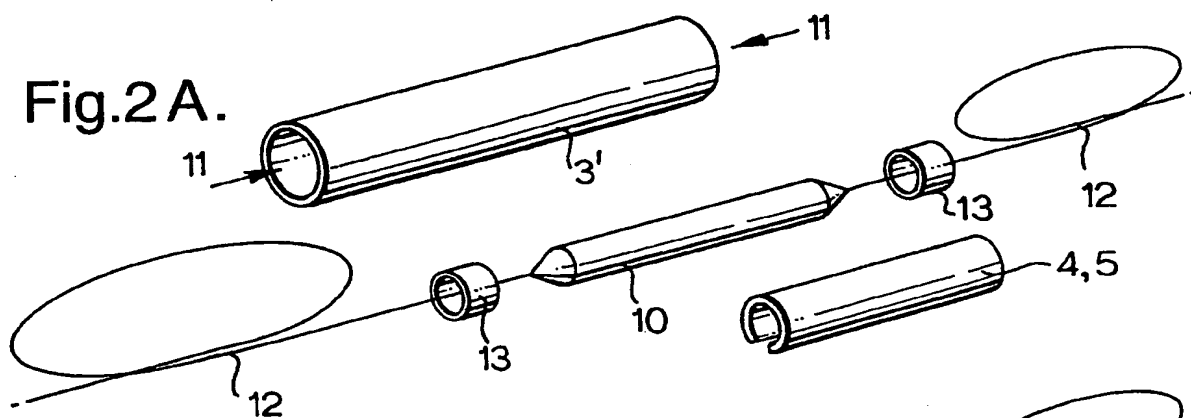
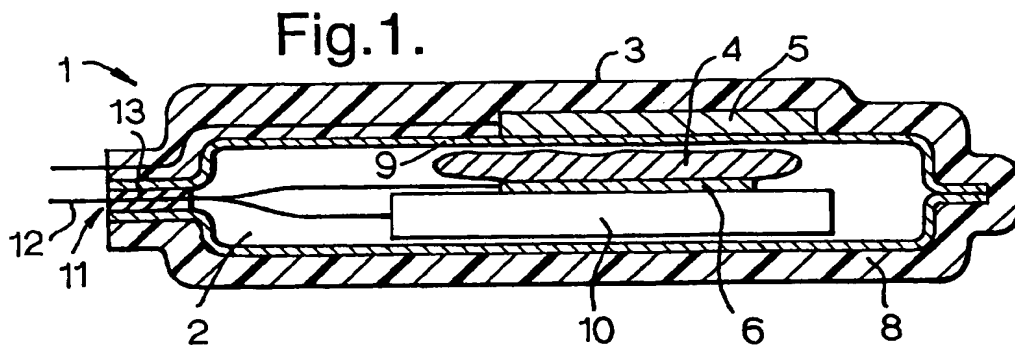
- 15
- providing a container (3);
 - providing a humidity control means (4);
 - providing a temperature control means (5, 6); and
 - accommodating the at least one circuit (10), the humidity control means (4) and the temperature control means (5, 6) in the container.

20 15. Method according to claim 14, wherein the temperature control means (5, 6) is pre-installed in the container (3).

25 16. Method according to claim 14 or 15, wherein the temperature control means (5, 6) comprises a heat sink.

17. Method according to claim 14, 15 or 16, wherein the container is substantially flexible.

30 * * * * *



DT04 Rec'd PC 13 JUL 2004

THIS PAGE BLANK (USPTO)

INTERNATIONAL SEARCH REPORT

PCT/GB 03/00059

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 G02B6/42

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 G02B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the International search (name of data base and, where practical, search terms used)

PAJ, EPO-Internal, WPI Data, INSPEC

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	PATENT ABSTRACTS OF JAPAN vol. 2000, no. 08, 6 October 2000 (2000-10-06) -& JP 2000 147285 A (FURUKAWA ELECTRIC CO LTD:THE), 26 May 2000 (2000-05-26) abstract; figure 2 paragraphs '0009!-'0012!	1,3,4,7, 8,11-16
Y	---	2,9,10, 17
	--- -/--	

☒ Further documents are listed in the continuation of box C.☒ Patent family members are listed in annex.

* Special categories of cited documents:

- *A* document defining the general state of the art which is not considered to be of particular relevance
- *E* earlier document but published on or after the international filing date
- *L* document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- *O* document referring to an oral disclosure, use, exhibition or other means
- *P* document published prior to the international filing date but later than the priority date claimed

- *T* later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
- *X* document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
- *Y* document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.
- *G* document member of the same patent family

Date of the actual completion of the international search

24 April 2003

Date of mailing of the international search report

09/05/2003

Name and mailing address of the ISA

European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,
Fax: (+31-70) 340-3016

Authorized officer

Riblet, P

INTERNATIONAL SEARCH REPORT

PCT/GB 03/00059

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT		
Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	PATENT ABSTRACTS OF JAPAN vol. 2000, no. 08, 6 October 2000 (2000-10-06) -& JP 2000 147290 A (FURUKAWA ELECTRIC CO LTD:THE), 26 May 2000 (2000-05-26) abstract; figure 2 paragraphs '0009!-'0012!	1,3,5,7, 8,11-16
Y		2,9,10, 17
X	US 5 919 383 A (SCOTTA FELICE ET AL) 6 July 1999 (1999-07-06) abstract; figures 1,3 column 1, line 13-18	1,3,5-7, 11-15
Y		2,9,10, 17
X	EP 0 929 206 A (LUCENT TECHNOLOGIES INC) 14 July 1999 (1999-07-14) abstract; figure 3 paragraphs '0003!,'0004!	1,3,5,7, 11-15
Y		2,9,10, 17
A	PATENT ABSTRACTS OF JAPAN vol. 1998, no. 06, 30 April 1998 (1998-04-30) -& JP 10 039178 A (HITACHI CABLE LTD;NIPPON TELEGR & TELEPH CORP <NTT>; HITACHI), 13 February 1998 (1998-02-13) abstract; figure 1	1,14
A	WO 01 07945 A (NEUKERMANS ARMAND P ;FOSTER JACK D (US); CALMES SAM (US); CLARK ST) 1 February 2001 (2001-02-01) page 47, line 24 -page 48, line 16; figure 24	1,14
Y	PATENT ABSTRACTS OF JAPAN vol. 2000, no. 13, 5 February 2001 (2001-02-05) -& JP 2000 292642 A (NIPPON TELEGR & TELEPH CORP ;NTT ELECTORNICS CORP), 20 October 2000 (2000-10-20) paragraphs '0025!-'0028!,'0040!; figures 2,6	2,9,10, 17

INTERNATIONAL SEARCH REPORT

Information on patent family members

PCT/GB 03/00059

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
JP 2000147285	A	26-05-2000	NONE	
JP 2000147290	A	26-05-2000	NONE	
US 5919383	A	06-07-1999	AU 5703698 A	29-06-1998
			EP 0943226 A2	22-09-1999
			WO 9824695 A2	11-06-1998
			CN 1238898 A	15-12-1999
			JP 2002516596 T	04-06-2002
			KR 2000057385 A	15-09-2000
EP 0929206	A	14-07-1999	US 5994679 A	30-11-1999
			EP 0929206 A2	14-07-1999
			JP 11243290 A	07-09-1999
			US 6114673 A	05-09-2000
JP 10039178 0	A		NONE	
WO 0107945	A	01-02-2001	CA 2340192 A1	09-03-2000
			CA 2344487 A1	13-04-2000
			EP 1210627 A1	05-06-2002
			EP 1119792 A2	01-08-2001
			EP 1121616 A2	08-08-2001
			JP 2002524271 T	06-08-2002
			JP 2002526803 T	20-08-2002
			WO 0107945 A1	01-02-2001
			WO 0013210 A2	09-03-2000
			WO 0020899 A2	13-04-2000
			US 6392220 B1	21-05-2002
JP 2000292642	A	20-10-2000	NONE	

THIS PAGE BLANK (USPTO)